UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

5054 PHYSICS

5054/22 Paper 2 (Theory), maximum raw mark 75

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Section A

1 (a) velocity has a direction/is a vector **or** speed does not have a direction/is not a vector
or displacement/time **and** distance/time
(**ign** speed is a scalar) B1

(b) (i) (–) 47 m/s B1

(ii) (a =) v/t **or** 47/0.0013 C1
(–) 3.6(1538 etc.) × 10^4 m/s^2 A1

(iii) (F =) ma **or** 0.16 × 3.6 × 10^4 C1
(–) 5.8(**or** 5.78461 etc.) × 10^3 N A1 [6]

2 (a) any **two** points:
depth/height;
density (of liquid);
atmospheric pressure;
g/gravitational field strength/acceleration of free-fall (**not** gravity) B2

(b) (i) (m =) ρV **or** 5.0 × 10^{-4} × 0.066 × 1000 **or** 3.3 × 10^{-5} × 1000 C1
0.033 kg (**not** factor of 10 caused by omitted density) A1

(ii) **mass of oil** = 0.033 (kg)/mass of water **above X**
or 1000 × 0.066/0.075 **or** 0.033/(5.0 × 10^{-4} × 0.075)
or 0.033/(3.75 × 10^{-5}) **or** inversely proportional to height C1
880 kg/m^3 A1 [6]

3 (a) (i) (M =) force × **perpendicular** distance **or** 840 × 5
(formula mark can be scored if not given in **3(a)(ii)**) C1
4200 N m A1

(ii) 350 N **or (a)(i)**/12 **and** calculated B1

(iii) weight of ladder/hose **or** friction at P/pivot/axle
(**not** air resistance; **ign**. friction) B1

(b) any **four** lines:
(mesh) traps air
air poor conductor/good insulator **or** convection prevented
(shiny surface) reflects/(good) reflector of IR/radiation/heat
(shiny surface) does not absorb/poor absorber of IR/radiation/heat
(**not** with radiator/emitter/conductor)
less heat transmitted/to **firefighter** B4 [8]

4 **(a)** (R =) V/I **or** 230/12 C1
19/19.2/19.1 Ω etc. A1

(b) (resistance) increases B1
as the temperature increases/gets hotter/gets heated B1

(c) (if switched on suddenly) low R → high/excess current
or it prevents high/excess current B1
bulb/filament/fuse blown/damaged
or wires damaged (**ign** lamp/filament lamp damaged) B1 [6]

5 **(a)** 0.80 **or** 0.0008 **or** 4 × 0.20 **or** 4 × 0.0002 **or** 4 divisions C1
(f =) 1/T **or** 1.2/1.25/1.3 (Hz) C1
1200/1250/1300 Hz A1

(b) any **three** of:
equal/same pitch/frequency (**ign** wavelength)
original note louder/ S quieter/softer (**ign** amplitude)
{ different qualities/timbres/
{ more frequencies/overtones/harmonics in S B3 [6]

6 **(a)** remain stationary/no effect/unaffected B1

(b) lifted up/attracted/stick to rod (**stated** not implied) B1
fall down/return to dish B1

(c) lifted up/attracted/stick to rod (**stated** not implied) B1
stay up/remain attracted B1 [5]

7 **(a)** any **two** of:
ionising **or** nuclear **or** α, β **and** γ (radiation)
always present/inescapable/in the environment/air/atmosphere/surroundings/
cosmic (radiation) **or** radiation from Sun/space/Earth/rocks B2

(b)

named activity:		how activity produces increase:	
nuclear tests		fallout/radioisotopes spread	
nuclear power		disposal of nuclear waste	
water leaks traced		disposal of radioisotopes/absorption of radiation	
radioactive ore mining		isotopes exposed	
smoke detector		disposal of radioisotopes	
specific industrial use		disposal of radioisotopes	
(nuclear) medicine	M1	disposal of radioisotopes/absorption of radiation	A1

[4]

8 **gravitational** collapse (of hydrogen cloud) **or** gravity pulls cloud together
or loss of GPE B1
temperature increase **or** gain of KE B1
fusion (of hydrogen) **or** hydrogen to helium B1
energy released **or** exothermic **or** equilibrium **or** pressure cancels collapse
or pressure increase (**not** density increase) B1 [4]

Section B

9 **(a)** **(i)** **one** correctly reflected ray (by eye) B1

(ii) **two** reflected rays traced back to an image B1
(labelled) image in correct position (by eye) B1

(iii) any **two** of:
virtual
full size/mag = 1 **or** same distance from mirror as C
laterally inverted (**ign** upright)
dimmer B2

(iv) more comfortable/no neck strain/no need to look up/reflects to eyes B1 [6]

(b) **(i)** (c =) 3(.00) × 10^8 (m/s) **or** 3(.00) × 10^5 (km/s) **or** used in equation B1
(f =) c/λ **or** (3.0 × 10^8/their **stated** value/330)/4.0 × 10^{-7} C1
7.5 × 10^{14} Hz **or** correct answer from **stated** value (incl. unit)
or 8.2/8.25/8.3 × 10^8 Hz A1

(ii) any **two**:
UV(radiation); X(radiation); γ(radiation) B2

(iii) **1.**

UV absorbed by skin	psoriasis destroyed	cells multiply less rapidly
X-rays absorbed by bones/not absorbed by flesh	shadow/image of bones	on film/CCD
γ-rays emitted by absorbed isotope	position/shape of organ etc. revealed	on film/CCD
tumour/cancer absorbs X/γ-ray	tumour destroyed	photons/energy/stops cells multiplying
bacteria absorb UV/X/γ-ray	Bacteria killed	sterilisation/stops bacteria multiplying

2.

UV:	X-rays:	γ-ray:	
damages eyes/skin cancer	cancer/hair loss/ radiation sickness	cancer/hair loss/ radiation sickness	B1 [9]

10 (a) (i) 32 000 N B1

(ii) two arrows/lines in correct direction by eye B1

(iii) scale given B1
two arrows/lines **and** correct resultant drawn B1
32.0 → 35.0 kN (2/3 sig. fig. only) B1
58.5 → 61.5° to horizontal
(2/3 sig. fig. only; don't penalise twice) B1

(iv) zero/no force/0 B1 [7]

(b) weight/gravitational force/gravitational attraction (**not** gravity) B1
higher in gravitational field **or** (to gravitational) potential energy B1
friction/air resistance B1
heat/thermal/internal energy B1 [4]

(c) (i) labelled axes **and** correct way round ($x \rightarrow t$) B1
straight line of positive slope B1
followed only by horizontal line (**ign** curve at junction) B1

(ii) distance travelled/time taken (from points) **or** calculate the gradient B1 [4]

11 (a) energy released/unit charge **or** power released/unit current C1
18 J/C **or 18** W/A A1 [2]

(b) (i) (t =) 5400 **or** 60 × 90 **or** 1.5 **or** 90/60 **or** (E =) Pt **or** 450 × 90
450 × 60 × 90 **or** 450 × 5400 **or** 4.0/4.05/4.1 × 10^4 **or** 0.45 × 1.5 B1
or 0.45 × 90/60 **or** 450 × 1.5 **or** 450 × 90/60 C1
2.4(3) × 10^6 J **or** 0.675 kWh A1

(ii) (Q =) E/emf (**ign.** emf = E/Q) **OR** (I =) 25 (A) **or** 25 × 5400
or 2.4(3) × 10^6/18 **or** 25 × 60 × 90 C1
1.3/1.35/1.4 × 10^5 C A1 [5]

(c) (i) laminated/iron core B1
two coils on core B1

(ii) turns ratio = 10:1 (may be shown on diagram) B1

(iii) diode symbol B1
symbol for battery/cell (**allow** either polarity w.r.t. diode) **and** complete circuit B1 [5]

(d) can be transformed/operate transformer/voltage can be changed B1
high voltage/low current transmission (possible)
or changing magnetic field B1
less energy/power loss **or** less heating (in wires) **or** thinner wires B1 [3]

MARKING SCHEME CODE:

B1 Independent Mark
C1 Compensation Mark:
awarded automatically if the answer is correct. i.e. the working need not be seen if the answer is correct; also given if the answer is wrong but the point is seen in the working.
M1 (Compulsory) Method Mark:
if not awarded subsequent A marks are lost (up to next B, M or C mark).
A1 Answer Mark.
c.a.o. correct answer only (including unit)
e.e.o.o. each error or omission
e.c.f. error carried forward:
it is usually awarded even where not specifically indicated.
i.e. subsequent working including a previous error is credited, if otherwise correct.

Incorrect units, errors in powers of 10 (except where the power of 10 comes from g = 10 N/kg) and unit multipliers are to be treated as arithmetical errors.

Correct numerical answers with incorrect units will normally gain preceding C marks even when the working is not shown.

Do not penalise a sig. fig. /fraction or a unit error more than once in the same question.

Sig. fig. Answers must given to 2 or more sig. fig. except where the answer is exactly 0.6, 2 etc. Answers given to 2 or 3 sig. fig. must be correctly rounded – but a 5 can produce a rounding up or down.